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ABSTRACT

The effect of role taking on written communication was examined by a compensatory treatment that provided subjects with specific anticipatory knowledge of the kind normally obtainable only by taking the viewpoint of the reader. Subjects in grades four, six, nine, and eleven learned to play a novel game from a televised demonstration. Experimental subjects also viewed another videotape, showing an ineffectual attempt by one person to communicate the game rules to another. The intent was to sensitize experimental subjects to possible communication difficulties without providing any positive guidance. Subjects then wrote instructions for playing the game. Overall, sensitization increased the number of essential ideas expressed, but did not affect clarity of expression. It increased the number of words written by the youngest subjects and decreased the number written by the oldest, and had the effect of nullifying a steep rise in wordiness observed between grades six and eleven among control subjects. Results suggested that an underlying growth in role-taking capacity manifests itself in different surface characteristics of writing at different ages. (Author)

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Role Taking in Written Communication Investigated by Manipulating Anticipatory Knowledge

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Role Taking in Written Communication Investigated by Manipulating Anticipatory Knowledge

In research on communication skills, the concept of 'taking the role of the listener' has suffered from being linked (as an opposite) with the Piagetian concept of egocentrism. Explanations that attribute communication failures to egocentrism tend to be vague or circular. Glucksberg, Krauss and Higgins (1975) have noted that "virtually any poor message (that is, a message conveying no useful information) could be characterized as egocentric" (p. 321). Both operationally and subjectively, role taking escapes this circularity. Asking subjects to describe how a situation would appear to a listener and asking them to construct a message for that listener will elicit different behaviors. One can experience 'taking the role of the listener' as cognitively different from thinking of what to say to the listener. Thus, Flavell (1974) has been able to treat role taking as an act, breaking it down into steps.

Testing for a causal connection between role taking and communication effectiveness is not straightforward, however. The same circularity arises that Glucksberg et al. have observed with egocentrism: communication effectiveness and role taking are judged by the same evidence. In principle, it should be possible to manipulate role taking experimentally and to observe its effect on communication effectiveness. But role-taking skills have been found difficult to induce experimentally (Flavell, Botkin, Fry, Wright, & Jarvis, 1968; Fry, 1966, 1969; Shantz 1976). A more fundamental problem is that training in relevant kinds of role taking entails practice or training in other aspects of communication task performance, and so, as Asher & Oden (1976) suggest, experimental effects on communication may not be due to changes in role taking.

The present study is an attempt to test for a causal link between role taking and communication by a somewhat oblique approach. Instead of trying to manipulate role taking behavior, we manipulate access to information of the kind role taking should be expected to yield. The experiment derives from an a priori analysis of how role taking may contribute to communication. This analysis is similar to that of Flavell (1974), but is expanded somewhat to fit the needs of this exposition. We assume that taking the point of view of the audience does not in itself produce better communications. Rather role taking should be considered as one link in a chain of events and conditions that includes the following:

1. Content. This is the knowledge base from which the content of the communication is to be drawn.

2. Anticipatory concern. The communicator, concerned about possible success or failure of the communication, looks ahead and tries to anticipate its effects.

3. Role taking. In trying to anticipate effects, the communicator takes the point of view of the receiver, considering what the receiver will and will not know, how the receiver will construe the message, etc.

4. Anticipatory knowledge. The outcome of role taking should be some knowledge of what the communication problems are in the task at hand--what the possible misunderstandings and gaps in understanding may be. Note that this is task-specific knowledge, not general knowledge of audience characteristics. It consists of items such as "When I say 'the third stoplight' people may not be sure whether to include the one they turned at."

5. Audience-related specifications. In order to become operative, this anticipatory knowledge of possible audience reactions must be translated

into specifications for the message--specifications such as emphasize a, avoid suggesting b, warn against c, distinguish clearly between d and e.

6. Execution. The communicator must now bring his linguistic resources to bear on constructing a message that meets the audience-related specifications along with any other specifications imposed on the task.

In actual practice the above steps would often be cyclical, of course, and not nearly so orderly. The steps are not set out as a process model of one-way communication but rather as a decomposition of what is implied in an expression like 'taking account of the listener's point of view.' This decomposition makes it clear that the formulation of a one-way communication can fail at a number of points. In an ordinary one-way communication task, however, points 3 and 4 are indissociable. A subject could not succeed at role taking yet fail to gain anticipatory knowledge, because success in role-taking consists in gaining anticipatory knowledge. Conversely, a subject could not succeed in gaining anticipatory knowledge without role taking, because the experimental paradigm bars any other source of anticipatory knowledge. The essence of our experimental procedure is that we do in fact intervene to supply anticipatory knowledge from another source.

Subjects were taught, by a televised demonstration, how to play an unfamiliar game. Their task was to write explicit instructions for playing the game. Experimental group subjects viewed an additional videotape, which showed someone trying to teach the game to someone else. The instruction-giver in the presentation gave consistently inadequate instructions and the instruction-follower consistently got things wrong as a result. What could be acquired from this presentation was, first, a general awareness that the task contained many possibilities for miscommunication (anticipatory concern) and, second, a good deal of specific knowledge about potential

trouble spots in the communication task--points of the game that might be overlooked, terms that might be misunderstood, and so forth (anticipatory knowledge). The experimental treatment, however, did not provide subjects with audience-related specifications nor did it provide them with any positive clues to or models of adequate communication. Thus it would not contribute directly to execution.

A positive treatment effect could be interpreted as evidence of a causal linkage between role taking and communication by the following line of inference: The experimental treatment could improve performance through increasing anticipatory concern or by contributing anticipatory knowledge. In either case positive results would indicate that subjects not receiving the experimental treatment were hampered in their communication performance by failure to take the point of view of the audience. If increasing anticipatory concern was effective it would be because it set into motion role taking and the ensuing chain of events postulated above. If increasing anticipatory knowledge was effective, it would indicate that subjects were not generating this knowledge themselves and hence that they were not successfully engaging in role taking. It would further indicate that if subjects were able to gain anticipatory knowledge through role taking, they would be able to use this knowledge to good effect.

The task used in this study differs from the tasks used in most research on one-way communication in two related ways. The task calls for a much more extended message and it calls for that message to be in writing. Glucksberg et al. (1975) have aptly termed the kind of communication investigated in most other research "referential communication." The task has typically been that of specifying a referent--a task that can often be accomplished with one well-chosen phrase. By contrast, complete execution

of our task would require the expression of 23 distinct ideas and the linking of them together in some comprehensible order. To perform such a task orally without feedback would not only be difficult but would be most unnatural. Extended communication without feedback from the receiver is uncharacteristic of the oral mode but is the most salient feature of the written mode of communication. Indeed, the mastery of writing may be considered to consist primarily of acquiring control over these features of written language that make possible explicit communication to a non-communicating receiver (Olson, 1976). It seems to us, therefore, that progress toward a fuller understanding of communication and role-taking abilities and of the relation between them can best be achieved through the investigation of extended written communication tasks.

Although Flavell et al. (1968) have obtained developmental data on tasks involving extended ideational content, available evidence did not seem sufficient to motivate firm age-related hypotheses in the present experiment. Subjects ranged in age from 17 down to 9 (the lowest age at which basic writing skills were deemed adequate to the task). It was expected that there would be an age at which providing anticipatory knowledge of communication difficulties would not be effective because subjects would lack the ability to translate that knowledge into audience-related specifications or would lack the necessary executive skills. It was also expected that there should be an age when subjects could profit from such anticipatory knowledge, and a still later age when it would not be beneficial, in as much as subjects could by then construct the knowledge for themselves through taking the point of view of the reader. There was, however, no basis for predicting what those ages would be, nor was it certain that they were all contained withing the age-range tested.

Method

Subject

There were 36 subjects at grade 4, 35 at grade 6, 38 at grade 9, and 42 at grade 11. Subjects at the two lower grades came from a large suburban elementary school serving a middle-income area. Subjects at the two higher grade levels were from a suburban high school. High school subjects were all in the 5-year or university-oriented curriculum, which was the stream that most of the elementary school subjects would be expected to enter, rather than in the 4-year or vocationally-oriented program. No objective data on comparability of the two subject pools are available, however, and so developmental shifts from grades 6 to 9 must be interpreted with some caution.

Materials

Two 12-minute videotapes were prepared as stimulus materials. The production was of amateur quality, done with Sony Porta-pack equipment. There was no indication from the reactions of any of the subject groups, however, that quality of production interfered with attention to or credibility of the stimulus presentations.

Instructional videotape. This tape demonstrated the playing of a board game invented for purposes of this experiment. The following unedited protocol from an 11th-grade subject describes all essential features of the game:

> To play this game you use a round disc and a playing board. On the disc are four mathematical signs around the edge of the disc.
>
> At one end of the board there is a straight rubber band. Place the disc with the signs up against the rubber band. Pull back and let

it go. On the board are several equations with the mathematical sign missing. When the disc lands over one of these it must cover the whole box where the sign must be. When this happens take the sign closest to the opposite end of the board. And that is your score. E.g., if + is closest and the two numbers are 5 and 10, you add the numbers together, if it's a x sign you multiply, etc. If there are two signs the same distance from the opposite end (a tie) then you can choose which sign you want to use. At the opposite end of the board there is another rubber band, if your disc rebounds off of this and lands on a box then you can chooose which sign you want of the four. When you make a score you continue playing until you miss and then it's the next person's turn. The game is won by the first person who reaches 1000 points.

The audio portion of the tape did not convey any explicit game rules but sometimes conveyed essential information in abbreviated, context-bound form. For instance, to convey the information that the game ended when one player obtained 1000 or more points, the tape showed one player recording accumulated points on paper, upon which the player was heard to say, "That's over 1000, so I win."

Sensitization videotape. This tape showed one of the players from the preceding tape attempting to teach the game to another person. Every rule given was either vague or incomplete, and the learner invariably performed some wrong action that was consistent with the instruction given. Correction was not by correctly-formed rules but by showing or by abbreviated restatement: "Not that way. Like this." "No. All the way." The intent, thus, was to avoid modeling any well-stated rules but to provide extensive exposure to poorly-stated rules and evidence of their effects on communication.

Procedure

Within grades 4 and 6, subjects were randomly assigned individually to three treatment conditions. Within grades 9 and 11, for practical reasons, intact classes were randomly assigned to treatments. The treatment conditions were (1) instruction only, in which subjects viewed the instructional videotape twice; (2) sensitization, in which subjects viewed the instructional videotape once and then the sensitization videotape once; and (3) sensitization plus script, which was identical to the sensitization condition except that in addition subjects were provided with a script of the sensitization videotape to refer to while writing.

After viewing the videotapes, subjects in all conditions were instructed to write out instructions for playing the game so that a classmate, who had not seen the videotape but who did have the game board available, could learn how to play the game.

The day after the experiment, all available grade 4 subjects were interviewed individually to determine the extent of their recall of the game rules. The actual game board was present at the time, so as to enable subjects to use pointing and demonstration in expressing the rules. Subjects were first asked to tell all the game rules as they remembered them (free recall), and then were questioned about any unmentioned rules to determine whether they had grasped and remembered them (prompted recall). Initial prompts were on the order of "There are two other rules you haven't said anything about." Later prompts were more directive; for instance, "Do you remember anything about when the game is over?" The primary purpose of this interview was to determine whether the youngest subjects had in fact comprehended and retained the game rules.

Scoring

Although the game consisted of 7 essential rules, these rules could be subdivided into 23 distinct ideas that might or might not be present in a subject's account of the game. These 23 ideas are listed in Table 1.

Insert Table 1 About Here

Subject protocols were independently scored by two raters and these ratings were averaged to yield the following variables:

1. Ideas. The total number out of the possible 23 ideas that were expressed in some fashion.

2. Clarity. The average rating, on a 4-point scale, of the clarity with which those ideas counted in item 1 above were expressed. The scale points were:

    1. Would be very unclear--would have to guess.
    2. Would probably get the idea but would be unsure of it.
    3. Would be able to grasp the point with certainty, but only with effort.
    4. Would grasp the point easily and with certainty.

3. Words. The total number of words in the text produced by the subject.

Through use of analysis of covariance, the following additional derived scores were obtained.

4. Wordiness. This is the score for words, controlled for number of ideas expressed.

5. Economy. This is the score for ideas, controlled for number of words. Logically it is the inverse of variable 4, but empirically it is not. Both economy and wordiness may increase with age, for instance, if

ideas and words both increase and are not highly correlated.

6. Ineffectual words. This is the score for words, controlled for both ideas and clarity. It is designated as 'ineffectual' words because it represents that part of the variance in number of words that has no correlation with either the number of ideas expressed or the clarity with which those ideas are expressed. Thus, within the confines of the variables considered in this study, this component of variance in number of words used has no effect.

Protocols of the oral interviews with grade four students were also scored by two raters and combined. They were scored more globally, however, since the intent was to assess comprehension of complete rules rather than memory for isolated details. Three scores were obtained: (1) the toal number of rules (out of a possible seven) adequately reproduced through free recall, (2) the total number of rules reproduced through free recall combined with those produced through prompting, and (3) a rating, on a five-point scale, of the clarity with which the rules were expressed (referred to hereafter as oral clarity).

Treatment of Data

The six variables drawn from written protocols were analyzed by univariate analyses of variance or covariance, using a fixed-effects model with two crossed factors--grade (4, 6, 9, and 11) and treatment (instruction only, sensitization, and sensitization plus script). It must be emphasized that analysis of covariance was not used in its conventional application, as a means of adjusting for pre-existing differences. Rather, it was used as a means of obtaining residual or derived scores. To avoid confusion on this point, results will be reported in terms of analyses of variance

performed on dependent variables as previously defined, and derived scores will be treated as scores in their own right rather than as adjusted versions of other scores.

Results

As indicated in Table 2, the number of ideas recorded by subjects varied significantly with grade and with treatment. There was also a highly significant interaction between grade and treatment. As Figure 1.a shows, this interaction is partly the result of a ceiling effect.

Insert Table 2 and Figure 1 about here

Grade 11 subjects in all conditions recorded close to the maximum possible number of ideas. The effect of sensitizing treatment seems to have been to lower the age at which ceiling is reached. Subjects in the instruction only condition do not approach ceiling until grade 11; those in the sensitization condition approach it by grade 9; and those in the sensitization plus script condition approach ceiling by grade 6.

Treatment had no significant relation to the rated clarity with which ideas were expressed. There was nevertheless a highly significant effect of grade.

With respect to number of words used, there was no significant main effect of treatment, but treatment did interact significantly with grade. As indicated in Figure 1.c, the effect of the sensitization treatments was to increase the number of words written by the youngest subjects and to decrease the number written by the oldest.

On the variable of wordiness (number of words used, controlling for

number of ideas), all effects were highly significant. As Figure 1.d shows, there is a tendency for wordiness to increase sharply with age from grades 6 to 11, and the effect of the sensitization treatments is to dampen this tendency. Essentially the same result is obtained with ineffectual words (number of words used, controlling for both number of ideas and clarity). As Figure 1.f indicates, the dampening effect in this case is even more pronounced, such that in the sensitization treatment groups there is no overall age increase in ineffectual words. This effect is reflected in the fact that the main effect of age is insignificant with respect to ineffectual words--the only dependent variable in the study of which this is true.

With respect to economy (number of ideas, controlling for number of words), both main effects and the interaction are significant. As a comparison of Figure 1.e with Figure 1.a indicates, the results for economy essentially reproduce those for ideas.

Results related to the oral interviews of grade 4 subjects are presented in Table 3.

Insert Table 3 about here

With prompting, subjects were able to recall all game rules with virtually no error. By free recall only they average four to five out of the seven rules. Treatment effects were analyzed by one-way analyses of variance or covariance. Treatment effects on free recall and oral clarity were not significant, although there was a tendency for subjects in the instruction only group to recall fewer rules spontaneously.

Among grade 4 subjects the number of rules produced in free recall was

significantly correlated with the number of ideas recorded in writing ($r = .45$, $p < .01$). Oral clarity did not correlate significantly with written clarity, however ($r = .18$). Within the grade 4 group there were significant treatment effects on both written ideas and clarity. Adjusting these scores for the corresponding oral scores did not appreciably change the results, although it reduced the magnitude of the differences slightly.

Discussion

The main object of this study was to investigate the effects of role taking on written communication by providing experimental subjects with the hypothesized 'fruits' of role taking and observing their effect on communication. The sensitization treatment was intended to impart specific anticipatory knowledge about possible communication difficulties--the kind of knowledge that would otherwise have to be derived from taking the perspective of the reader.

The experimental treatments had a marked effect on the number of essential ideas that subjects embodied in their communications, but they did not have any overall effect on the rated clarity with which those ideas were expressed. Given the nature of the task, this result is quite reasonable. In communicating some complex body of content such as the rules of a game, the most important failing is likely to be omission of small but essential details. In normal two-way communication, feedback from the receiver often takes the form of questions involving what if? which one? how do you tell? etc. The response to these questions often consists, not of a clearer statement of an idea already expressed, but of additional information neglected in the initial exposition. A major function of role taking (that is, looking at the task from the point of view of the receiver)

is to enable the communicator to anticipate these informational needs and supply the relevant information on the initial attempt. Accordingly, the fact that experimental group subjects did supply more essential ideas may be taken as an indication that they were functioning more in the manner of people who took the role of the receiver.

Although there was a highly significant age trend toward greater clarity in the expression of ideas, treatment had no significant effect on this trend. Several reasons may be suggested for this result. Clarity of expression may simply be harder to change; it may depend mainly on executive skills unaffected by short-term interventions. Even if clarity is affected to some extent by taking the viewpoint of the reader, the experimental treatments could not be expected to duplicate that kind of effect. In the sensitization videotape we tried to anticipate the items of content subjects might fail to communicate. We could not, obviously, anticipate all the many kinds of inadequate expressions that subjects might use. Consequently, the treatment was more relevant to ideational content than to clarity of expression. Finally, it should be noted that the average clarity ratings of even the lowest-scoring groups indicated a minimally adequate level of clarity. The lowest mean scores fell about halfway between scale points labeled "Would probably get the idea but would be unsure of it" and "Would be able to grasp the point with certainty, but only with effort." While such scores indicate considerable room for improvement, they also indicate that in the raters' estimation the ideas expressed would, by and large, get across to a reader. Thus there was no obvious demand, within the context of the task situation, to strive for greater clarity.

The number of words used in expressing the game rules increased

steeply and almost linearly from grade to grade, with grade 11 students in the instruction only group averaging more than three times as many words as the grade 4 subjects. This is a much greater difference than was found by Harrell (1957) over a similar age-range. With subjects retelling a story viewed on film, Harrell found subjects of age 15½ writing compositions about 50% longer than subjects of age 9½. Interestingly, in the present study, if word counts are adjusted statistically for number of ideas (yielding the variable designated here as wordiness), then the difference between grade 11 and grade 4 subjects in the instruction only group reduces to the same magnitude as was observed by Harrell. Thus the pre-eminent effect of quantity of ideational content is again manifested. The effect of experimental treatments on pure verbal output is best examined in the derived variable, ineffectual words, which is the number of words used, when clarity and number of ideas are held constant statistically. Here the normal trend, as indicated by the performance of subjects in the instruction only group, is for ineffectual words to increase from grades 6 to 11. The experimental treatments had no effect at all on this variable in grades 4 and 6, but they seem to have had the effect of eliminating the upward trend in grades 9 and 11. It appears, then, that the effect of sensitizing older subjects to the possibilities of miscommunication is to induce them to focus more sharply on essentials, reducing superfluous elaboration, whereas the effect on younger subjects is to make them include more details.

Fry (1966) using 12-year-old subjects, found that the main effect of training on one-way communication tasks was to reduce the number of words used. Fry's result is consistent with the present findings, but it does not necessarily reflect the same effect. Fry's subjects may have learned that

terse messages generally work better, or they may simply have learned how to expend less effort.

In one experimental treatment variation, subjects not only viewed the sensitization videotape but were also provided with a script of the videotape for reference. In the grade 9 and 11 groups, the effects of this treatment closely paralled those of the treatment without script. In grades 4 and 6, however, the effects varied. Viewing the sensitization videotape without script seemingly had no effect on grade 6 subjects, whereas given the script they approached ceiling in their coverage of essential ideas. In grade 4, on the other hand, performance of subjects in the sensitization plus script condition was between that of subjects in the sensitization condition and those in the instruction only condition on all the underived variables. The study does not provide any basis for explaining these variations. A tentative explanation, which would account for the results, is that by grade 6 subjects already appreciate the need for exhaustiveness in reporting content, but they are deficient in retrieval. The script, therefore, serves primarily as a memory aid. In conducting the experiment with grade 4 subjects, however, it was observed that those in the sensitization plus script condition actually referred very little to the script. Perhaps they lacked the ability to scan a written text or perhaps they saw no reason to do so, not having yet acquired an appreciation of the need for exhaustiveness.

Overall, the results suggest that role taking is a significant variable affecting written communication in subjects across the whole range of ages treated in this study. At the youngest age, failure to take the point of view of the reader leads to omission of significant content. At the older, adolescent ages, it leads to a lack of focus on essentials and an

attendant verbosity. Before feeling confident in this conclusion, however, we need to consider alternative explanations of the results. One explanation, impossible to rule out altogether, is that the experimental treatments simply led to better mastery of the content to be communicated. Subjects in the instruction only group viewed the same instructional videotape twice. Subjects in the experimental conditions viewed what could be regarded as two different presentations of the same content. They might, therefore, simply have received better instruction. The oral interviews with grade 4 subjects were used primarily to establish that these youngest subjects had in fact comprehended and retained all the game rules. Recall, as tested through free and prompted recall, did prove to be nearly perfect. Free recall was not perfect, but controlling for differences in free recall did not eliminate treatment effects on written communication. Thus we are prepared to argue that knowledge of content was at or near ceiling for all subjects, and therefore not a likely source of variation in treatment results.

Another perspective on the experimental treatments is the following. The instructional videotape showed only the right way to play the game. The sensitization videotape, on the other hand, by demonstrating a variety of wrong moves and misconceptions, provided contrasts which highlighted the distinctive and critical features of the game. Thus the sensitization videotape may have served to isolate and make prominent those very elements which were scored in subjects' protocols as essential ideas. This we acknowledge to be a true characterization of the experimental treatments. We would argue, however, that the above explanation is not an alternative to an explanation in terms of role taking; it is simply a way of elaborating such an explanation. Among people who already understand a game and

know all its rules, the concepts of 'critical,' 'distinctive,' 'central,' etc., as applied to the game rules, have no significance. Experienced bridge players never have to give a thought to how the game is different from pinochle. It is only when one is trying to teach the game to someone else that such relative concepts take on significance. Consequently, to say that the sensitization videotape made prominent the distinctive elements of the experimental game is simply a more precise way of characterizing the knowledge which could be gained by viewing the game from the learner's perspective.

The present study suggests that psychological experimentation has something to contribute to an understanding of the development of writing skills. Valuable information on the normal course of writing development has come both from studies that collected writing samples under controlled task conditions (e.g., Harrell, 1957) and from studies that have examined writing produced under more normal and varied conditions (e.g., Britton, Burgess, Martin, McLeod, & Rosen, 1975). To our knowledge, however, the present study is unique in looking at writing protocols with both age and experimental conditions systematically varied. Had the present study been limited to the instruction only condition, the results would have shown that as subjects grow older they communicate more ideas, with greater clarity, and use more words in doing so. These findings would then tend to collapse into an undifferentiated statement that 'older is better'--the most degenerate form of developmental finding. The experimental results indicate that the several dependent variables are not simply manifestations of the same progression toward more mature writing skills. Sensitizing subjects to possible communication difficulties had the effect of increasing number of ideas communicated, without influencing clarity. Moreover, it had

the effect of increasing the number of words written by the youngest subjects while decreasing the number written by the oldest. Instead of simply pointing to growth in a number of correlated surface characteristics of writing ability, the experimental results point to growth in an underlying communicative capacity which manifests itself in different surface characteristics of writing at different ages.

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Footnote

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Table 1

Checklist of 23 Constituent Ideas in Rules
for Playing Experimental Game

1. That the game involves shooting the puck
2. That the puck is propelled by a rubber band
3. That the rubber band to use is the one situated at the front (open) end of the board
4. That the object is to make the puck land on one of the squares
5. That it is possible to get points by landing on one of the squares
6. That the puck must completely cover the square
7. That when a box is covered by the puck, an arithmetic operation is to be performed on the two numbers on either side of the box
8. That the operation to be performed is determined by the signs on the puck
9. That the sign to be used is the one farthest away from the shooter
10. That the player's score for the turn is the numerical result obtained by the arithmetic operation
11. That a player gets another turn if and only if he scores
12. That scores accumulate from turn to turn
13. That if the player calculates a wrong result, he gets no score
14. That a wrong answer ends the player's turn
15. That there is a special rule for ties
16. That a tie occurs when two arithmetic signs are equally far forward
17. That when two signs are equally far forward and the puck covers a square the player has a choice of operation
18. That the choice is between operations indicated by the two tied signs
19. That there is a special rule for rebounds
20. That a rebound occurs when the puck bounces off one of the rubber bands at the far end of the board
21. That if the puck rebounds before landing on a square, the player has a choice of operations to perform
22. That the choice is between the 4 operations shown on the puck
23. That the game ends when a player's cumulative score reaches 1000

Table 2

Univariate F Ratios and Probabilities for Grade, Treatment, and Interaction Effects on Six Dependent Variables

	Grade Level (df = 3;139)[a]		Treatment (df = 2;139)[a]		Grade X Treatment (df = 6;139)[a]	
Dependent Variable	F	p	F	p	F	p
Ideas	56.388	.001	5.032	.008	3.593	.002
Clarity	62.335	.001	1.342	.265	1.365	.233
Words	42.862	.001	1.356	.261	4.156	.001
Wordiness	6.618	.001	6.856	.001	2.805	.013
Economy	14.597	.001	10.791	.001	2.273	.040
Ineffectual Words	2.184	.093	7.120	.001	2.690	.017

[a]Error df for wordiness and economy is 1 less than number shown, error df for ineffectual words is 2 less, because scores were derived on the basis of within-cells regression slopes.

Table 3

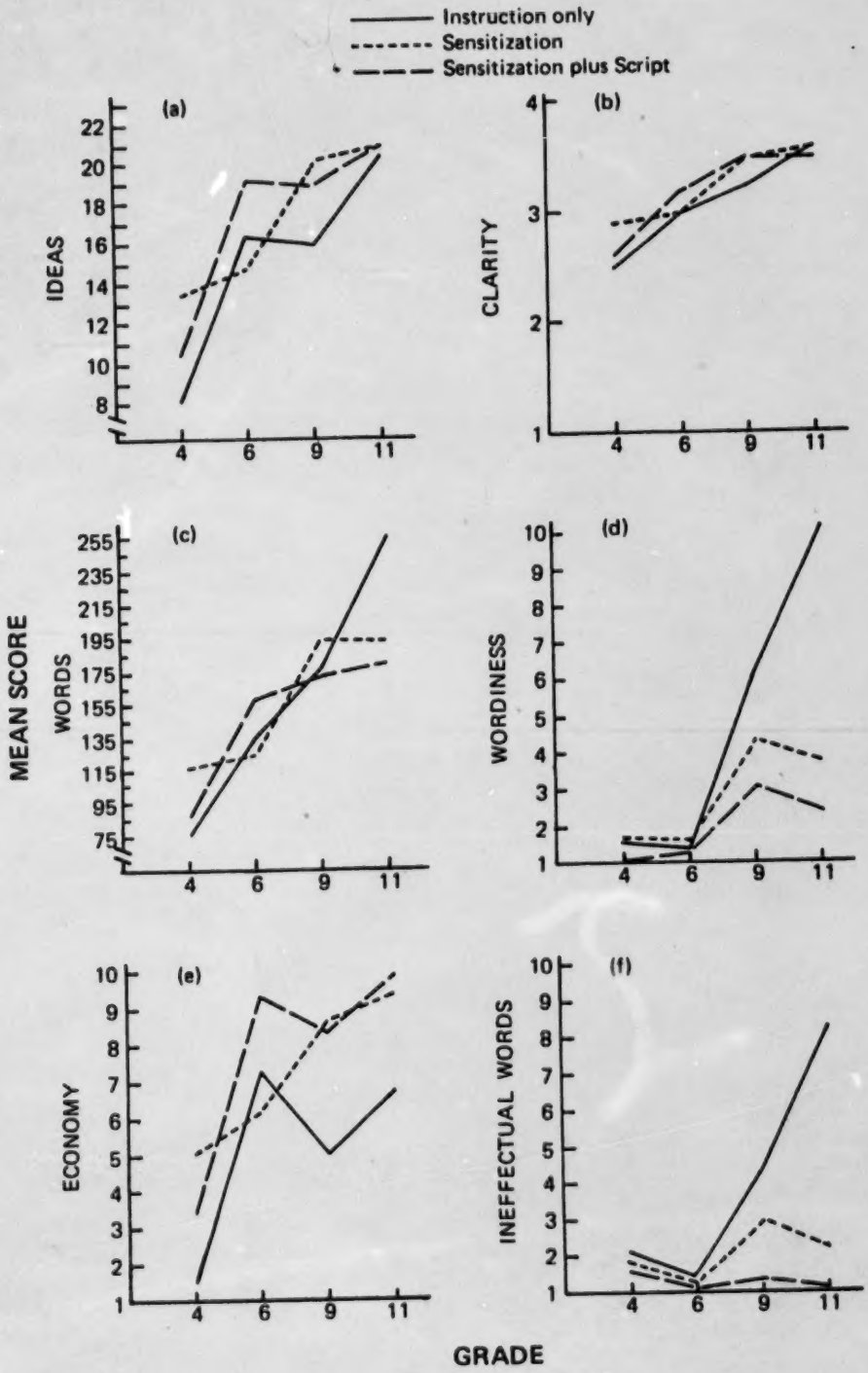
Comparisons, by Treatment, of Ratings from Oral Interviews and Written Protocols of Grade 4 Subjects

Variable	Treatment: Instruction only (N = 11)	Sensitization (N = 10)	Sensitization plus script (N = 9)	Significance of treatment differences
Oral interviews				
Rules recalled				
Free recall	4.2	5.2	5.1	<.20
Total (7)[a]	6.7	6.5	6.8	___
Clarity (9)[a]	5.1	5.7	4.1	>.20
Written protocols				
Ideas (23)[a]	7.6	14.0	9.1	<.01
Clarity (4)[a]	2.5	3.0	2.6	<.02
Ideas, adjusted for oral free recall	8.5	13.2	8.7	<.02
Clarity, adjusted for oral clarity	2.5	2.9	2.7	<.04

[a]Maximum possible score.

Figure Caption

Figure 1. Mean scores on six dependent variables, by grade and treatment. Ideas and words are actual counts. Clarity is scored on a 4-point rating scale. The remaining variables are derived variables, arbitrarily scaled.


Instruction only
Sensitization
Sensitization plus Script
(a)
IDEAS
22
20
18
16
14
12
10
8
4
6
9
11
(b)
CLARITY
4
3
2
1
(c)
WORDS
255
235
215
195
175
155
135
115
95
75
(d)
WORDINESS
10
9
8
7
6
5
4
3
2
1
(e)
ECONOMY
(f)
INEFFECTUAL WORDS
MEAN SCORE
GRADE